Surficial iron conversion mechanisms for the surface of Mercury

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The spectral evidence for the presence of iron on the surface of Mercury is equivocal. Estimates of strength of the 0.9 to 1.2 micron coordination band range from weak to non-existent. This band, and the bands around 1.3 and 2.1 microns provide a measure of iron bound in pyroxenes, feldspars and olivine. This band is ubiquitous for spectra of Earth, the Moon, and Mars. It is reasonable to believe that Mercury, with its high density and visual similarity to the Moon, would have similar or greater quantities of total iron and probably a greater amount of iron contained in the surface minerals.

There are several space weathering mechanisms which could account for the low spectral contrast in the one micron band. These include particle size effects, iron migration and/or evaporation, and iron reduction. The surface temperatures of the illuminated side vary between 590K and 750K depending on Mercury's orbital position and location on Mercury's surface while the nighttime temperatures is about 600K lower. This large temperature change could result in very finely divided surface material - a material state which lowers spectral contrast. In addition, the high temperatures increase the mobility and vapor pressure of iron. The high solar flux on the surface of Mercury creates a surficial regime of hot atom chemistry. In addition the flux of hydrogen results in a reducing environment. Free iron, a likely end product of these weathering mechanisms, has no absorption in the 1 micron region. This work was supported by Galileo and by the Planetary Geology and Geophysics program.

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